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U. S. FOREST SERVICE

RESEARCH NOTE LS-35

LAKE STATES FOREST EXPERIMENT STATION · U. S. DEPARTMENT OF AGRICULTURE

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Variable Stocking Is a Problem in Experiments Involving Direct Seedings of Northern Red Oak

That direct seeding may create problems in experiments where uniform stocking and precise accountability of each tree are requisites was indicated in a recent study involving northern red oak.

In 1952, direct seedings of northern red oak acorns *(Quercus rubra L.)* were used to establish several small experimental plots[1] near Galesville, Wis. The purpose was to study the effect of competing vegetation and damage by wild animals upon the survival and growth of the small trees during the ensuing 10-year period. Problems of suppression by the forest overstory were eliminated by utilizing a 1-acre clearing from which all timber had been removed several years earlier. However, this previously forested site never had been cultivated, and in 1952 it was covered with herbaceous plants and woody shrubs common to the locality.

In planning the study, it was assumed that a fairly uniform stocking of about two northern red oak seedlings per "hill" would be obtained by planting three acorns in each 18 x 18-inch scalped (de-sodded) spot. For a number of reasons, this objective was not attained. First, the acorns either failed to germinate or were pilfered by rodents in more than one-sixth (18.3 percent) of the 1,250 seed spots (Table 1). These 229 voids affected the adequacy of the initial stocking, but wild oak seedlings "restocked" 22 of these blank spots 2 to 10 years after the direct seedings were made.

The lack of uniformity in stocking of occupied spots at the end of the first growing season (mid-September) is shown below:

Number of oak seedlings per spot	*Percentage of spots in each numerical category*
1	31.8
2	37.1
3	27.8
4	3.1
5	0.2
Total	100.0

Why more than three oak seedlings occur in 3.3 percent of the occupied spots is a matter for conjecture. Some possible explanations are: (1) more than three acorns were accidentally planted in these few seed spots, (2) an occasional acorn sent up multiple shoots, or (3) the extra trees were "wildlings" planted by squirrels.

This initial variability in stocking was augmented during the 10-year period of the regeneration study by a permanent increase in the number of oak seedlings on 1.3 percent of the seed spots and by interim fluctuations on 8.6 percent of them; the latter started and ended with the same number of trees (Table 1). The permanent increase in stocking probably was the result of single-stem trees forming new shoots from their root collars or the introduction of "wildlings," whereas the interim fluctuations could be due to the loss of tops by shading or animal damage and the subsequent resprouting of these missing or "dead" seedlings.

Although a perfectly uniform stocking of seedlings over the entire area of the site would have been advantageous, there was good accountability for the trees on 71.8 percent (897) of the 1,250 seed spots involved in the experiment. During the 10-year study, eighteen 100-percent tallies were made for the northern red oak seedlings occupying these 897 spots. An analysis of these data shows no change in stocking on 307 spots

[1] *These plots are located on the Hardies Creek Timber Harvest Forest, a state-owned, 53-acre mixed-oak tract. This area is used for research and demonstration on a cooperative basis by the Wisconsin Conservation Department, the U.S. Forest Service, and the Extension Service of the University of Wisconsin.*

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TABLE 1. — *Condition of stocking in direct seeding of northern red oak at the end of the tenth year*

What happened	Total seed spots in each category 1/	
	Number	Percent
1. No trees came up in the spots during the 10-year period	207	16.6
2. Spots were blank for 2 years or longer but eventually were occupied by wild seedlings	22	1.7
3. The stocking of seedlings in individual spots was unchanged for 10 years	307	24.6
4. Same number of seedlings at beginning and end of 10-year period, but with interim variability	107	8.6
5. Stocking of spots decreased and--		
a. Spots were still occupied at the end of the 10-year period	288	23.0
b. No trees were left in spots	302	24.2
6. Permanent increase in stocking	17	1.3
TOTAL	1,250	100.0

1/ All comparisons are based upon the counts at the end (September) of the first growing season.

and a permanent decrease in the number of trees on 590 of them (Table 1).

The obvious alternative to direct seedings of northern red oak acorns is the planting of nursery-grown trees. This was done in 1953 and 1954 on 1,174 18 x 18-inch scalped spots. Both 1-0 and 2-0 seedlings proved satisfactory. By their use, it was possible to obtain a 100-percent initial stocking uniformly dispersed over the entire area of the site.

Because of the success obtained with nursery stock, its use in preference to direct seedings is recommended in all future studies where *precise* accountability of individual trees is a requisite. Subsequent mortality, damage to tops and lateral branches, formation of new sprouts, etc., thus can be equated with a known single-tree stocking for each spot. Another advantage of nursery stock is the speed and low cost of subsequent examinations of planted plots compared to seeded areas. It is much easier to find or account for one tree per spot than for several. This is true particularly during the growing season when the small oaks are overtopped or surrounded by lush vegetation.

In some cases the additional cost of growing and transporting nursery stock and hand-planting the trees might have to be justified in terms of greater research accomplishments.

A final consideration in favor of using trees rather than acorns is that the weaker, poorly formed seedlings can be eliminated *before* they are planted. The practical result of this roguing process in the tests discussed here was that both the 10-year survival (71 as compared to 64 percent) and the average 10-year height (79 versus 62 inches) were better for 1-0 nursery stock than for seedlings of the same age grown directly from acorns.

January 1964

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